ARI NEWSLETTER

U.S. Army Research Institute for the Behavioral and Social Sciences

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IMPROVING PERSONNEL CLASSIFICATION IN THE ARMY:

Fitting the Right Soldier to the Right Job

A new PC-based management tool, called the Enlisted Personnel Allocation System (EPAS), is a versatile instrument that can be used to make personnel classification increasingly sophisticated.

From research and personal experience, we have come to understand that those who do well on the Army's entry tests tend to perform better on the job than those who receive lower scores on these tests. "Soldier quality" is a term often equated with high scores on the Armed Forces Qualification Test (AFQT), an important tool in the selection process. We understand the advantages of having a force predominantly composed of those who score in the top half of the applicants taking this test — in other words, those who fall within AFQT Categories I to IIIA. What is less well understood is that, with no increase in AFQT scores at all, we can achieve the same benefit as we do now

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Weapons Qualification Training

Inside

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Director's Message

Study the winners. We can't learn to produce success by only studying failure. Research often focuses on the negative, identifying deficiencies and evaluating alternatives. This is a strategy for identifying and clarifying the operational issues; however, this is not a strategy for solving problems. For example, we have developed a new personnel management tool called the Enlisted Personnel Allocations System or EPAS. EPAS will increase the number of winners in the Army.

As the lead article describes, EPAS will allow recruits to be assigned to jobs that yield the best performance for the Army, not just to jobs for which the recruits are minimally qualified. The right people in the right jobs... a sure formula for success.

This newsletter provides many more examples of ARI's efforts to enhance the quality and training of future soldier's and leaders. If we are to make that future happen, we need to continue to study winners and develop the tools to make every soldier a winner.

(Continued on page 1)

through selection, merely through better assignment of recruits to jobs at initial entry. We currently take good advantage of the possibilities of improved soldier performance through careful selection but have, up to now, only scratched the surface in terms of what we can achieve through improved assignment. This is about to change.

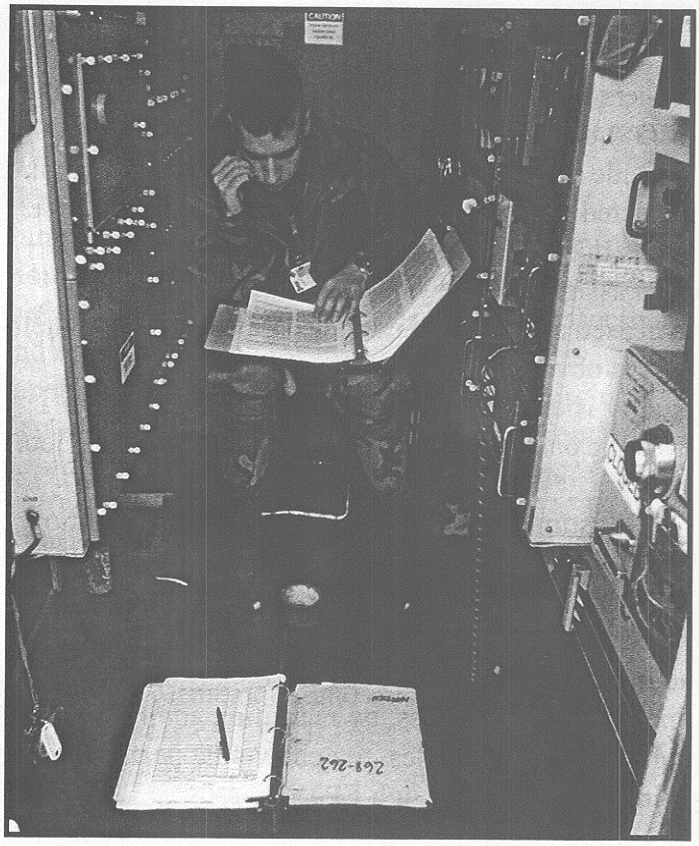
We currently administer the Armed Services Vocational Aptitude Battery (ASVAB) to new recruits. This test battery contains useful information about which recruits are best suited for which jobs. However, because the current training reservation and assignment system, known as REQUEST, is guided principally by the need to fill immediate vacancies in training seats, much of that information is not utilized. The system does not ask how recruits can be assigned to yield *maximum performance* for the Army. Instead, it asks if these recruits are *minimally qualified* for the jobs the Army is currently most interested in filling. Improved Army performance is only a minor consideration for the current system.

Enlisted Personnel Allocation System

The U.S. Army Research Institute (ARI), working with the Office of the Deputy Chief of Staff for Personnel (ODCSPER) and the Army Recruiting Command (USAREC), has developed a new automated system designed to enhance REQUEST, pushing it toward more performance-based assignments. This new PC-based management tool is called the Enlisted Personnel Allocation System (EPAS), and will function as a component of REQUEST. The current development schedule calls for field testing beginning in FY 2000.

How Does It Work?

EPAS employs three steps in order to accomplish its objective of moving REQUEST toward more performance based assignments. First, EPAS evaluates recruits' predicted performance using their ASVAB aptitude information, against job training requirements, in order to distinguish those jobs in which recruits would best perform. Second, EPAS considers all possible matches of recruits into job training classes over the entire year, and recommends those matches which produce the highest total predicted performance. By doing this, EPAS is able to introduce optimization into what is a sequential assignment system, making optimal use of the flexibility provided by the Delayed Entry Program. This allows recruits to delay the start of basic training. Finally, EPAS recommendations are generated within a framework that obeys monthly and annual training management goals and training seat availability.



EPAS divides the assignment process into two phases:

(1) In the first phase, a large model with the features just described is solved and updated each week. It is used to generate an ordered list (from best to worst) of job training recommendations particular to each recruit group.

(2) In the second phase, recruits assignment, the recommendations are merged with those generated by REQUEST procedures and presented to the recruit by the career counselor.

Payoff

For understandable reasons, soldiers with high aptitude for their jobs perform those jobs better and take less time to train than do soldiers with lower aptitude. For example, on a Training Set Fire Observation exercise, Category I-IIIA Fire Support Specialists were able to locate the target 50% more of the time than were their Category IIIB-IV counterparts, performed considerably better (18% better) at determining the appropriate shell-fuse combination, and successfully completed a Multiple Launch Rocket System firing exercise in 11% less time.

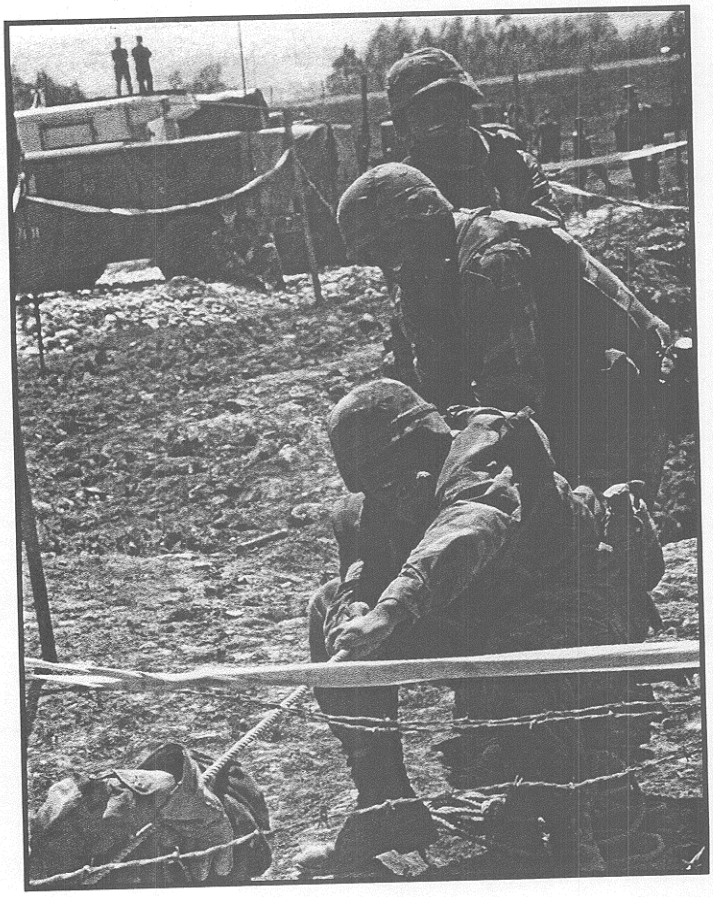
These effects would be even more pronounced for soldiers assigned to the Military Occupational Specialty (MOS), for which they had the best MOS-specific aptitude scores. By basing the job-person match on expected performance, EPAS increases the aptitude levels of soldiers for the jobs to which they have been assigned. The value of having soldiers with increased aptitude and predicted performance in their jobs is obvious: it is a force multiplier. Soldier quality is extended from a static AFQT notion to a dynamic one that reflects aptitude for the assigned job.

ARI estimates that the classification optimization gains are about the same size as those conferred by current selection-for-service screening methods. Alternatively, it is estimated that it would cost an additional $200M per accession cohort using current operational procedures, by recruiting additional high-quality candidates, to achieve the performance gains obtainable through EPAS.

As a collateral benefit, ARI research has shown that improved predicted performance (via optimized classification) would likely lead to modest improvements in first-term completion rates. We estimate an indirect benefit of 300 – 400 fewer attritees per accession cohort with optimized classification.

New Capabilities

EPAS is a versatile tool that can be employed to make personnel classification increasingly sophisticated. For example, the current version employs the existing nine Army aptitude area composites (built from the ASVAB tests). Recent ARI research has estimated a new set of ASVAB composites which are much better predictors of soldier job performance. Their anticipated use in 2nd generation EPAS will boost classification gains quite considerably and can be accomplished seamlessly.



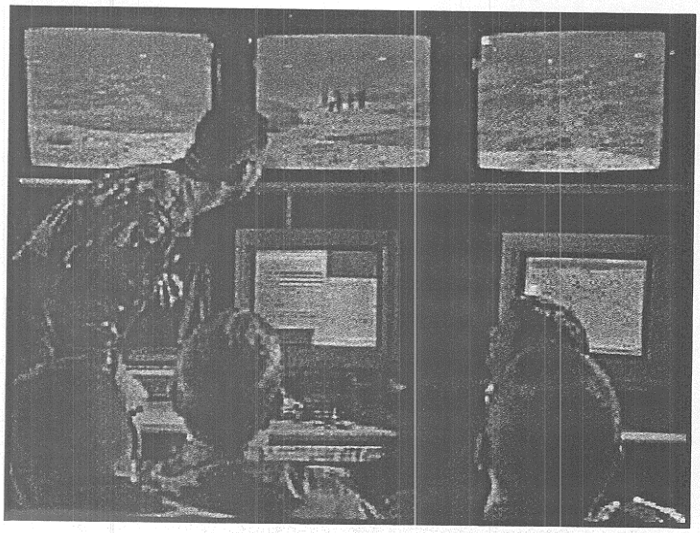
To take another example, EPAS is currently set up to maximize predicted performance, but could be set up to minimize first-term attrition or a combination of the two, once the necessary supporting research is complete. The principle is simple: EPAS serves as a vehicle with an engine which can be readily swapped for another, better one, once the new engine has been properly calibrated.

For additional information, please contact Dr. Pete M. Greenston. ARI-Selection and Assignment Research Unit, [redacted]

DEVELOPMENT OF STRUCTURED TRAINING FOR THE CLOSE COMBAT TACTICAL TRAINER (CCTT)

The U.S. Army is currently fielding the CCTT as the first member of the Combined Arms Tactical Trainer (CATT) family. The CCTT, as the successor to the Simulation Networking (SIMNET) system, provides a virtual environment supporting the collective training of armored and mechanized infantry units, including combat support (CS) and combat service support (CSS) elements.

The CCTT is the first fully Distributed Interactive Simulation compliant system. This system includes networked vehicle simulator manned modules operating on a synthetic battlefield, along with computer-generated Semi-Automated Forces (SAF), computer networks and protocols, CS and CSS workstations, and After Action Review (AAR) support systems.



The Project Manager (PM) and Training and Doctrine Command System Manager (TSM) for CATT have recognized the need to field CCTT as a complete integrated training system. In this regard, they have sponsored the ARI Armored Forces Research Unit (AFRU) at Fort Knox for almost three years of research and development relating to training packages and tools for the CCTT. This research and development provides training methods and prototype software for future acquisition and fielding of simulations as integrated training systems.

Structured Training for the CCTT

The ARI AFRU has developed a structured training methodology for exploiting the use of virtual and constructive simulations, starting with development of the largely SIMNET-based Virtual Training Program (VTP) at Fort Knox in 1993. Structured training is systematic guided practice addressing specific training objectives (tasks, conditions, and standards) in a planned sequence that commonly increases task performance difficulty (see ARI Newsletters, Spring 1995, Summer 1996, and Winter 1998). Evidence from monitoring the VTP and similar programs indicates that structured training exercises provide effective and efficient means for using simulation capabilities. For example, see (ARI Research Report 1679, *An Initial Evaluation of a Simulation-Based Training Program for Army National Guard Units).* Beginning in mid-1996, the ARI AFRU tailored and applied structured training methodology to the development of exercises and complete training support packages (TSPs) for the CCTT. This has resulted in the development, evaluation, refinement, and implementation of approximately 60 CCTT TSPs.

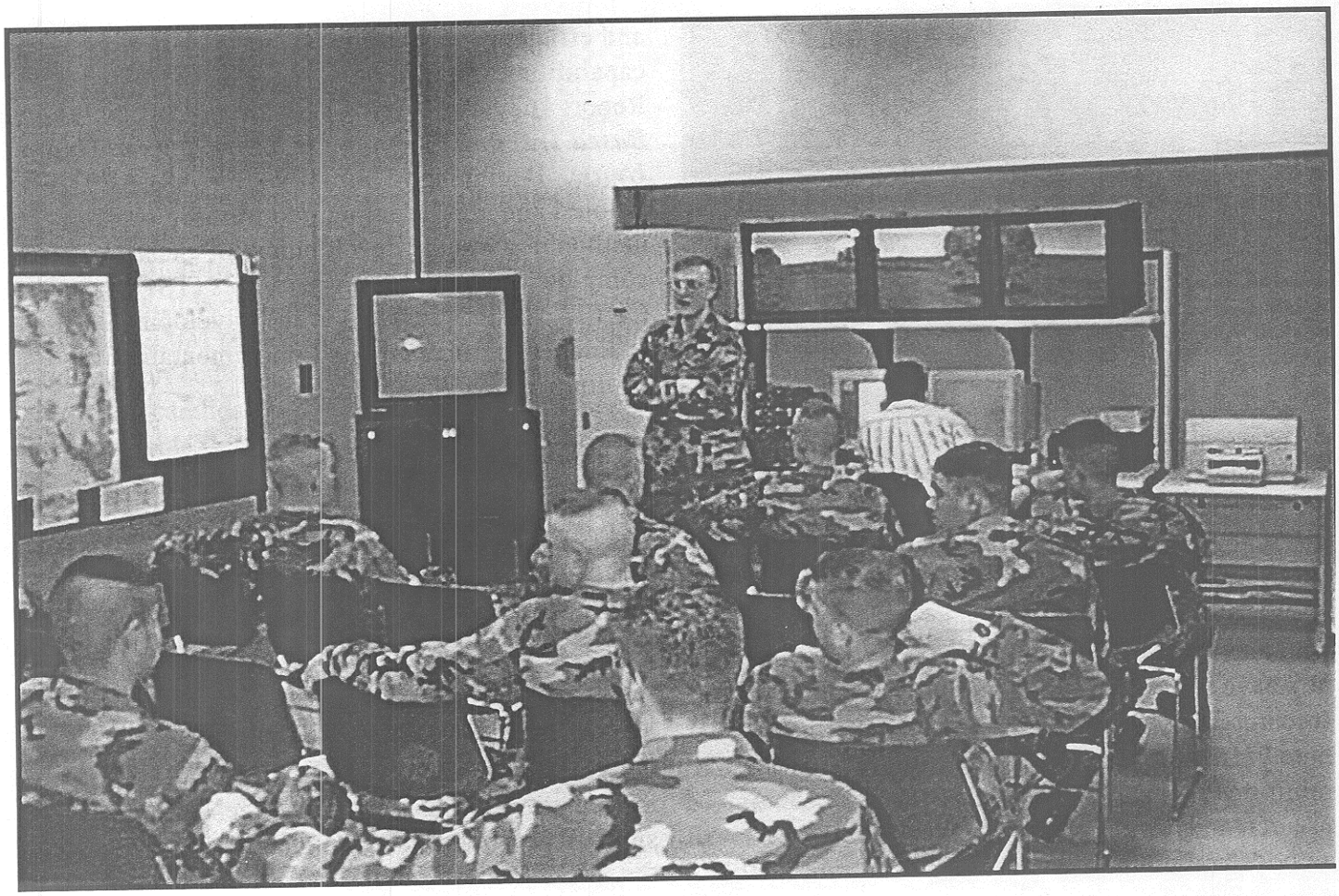
In the first CCTT structured training project (Structured Training for Units in the CCTT, or STRUCCTT), an AFRU contractor team developed TSPs for 40 CCTT exercises. The missions addressed were movement to contact, deliberate attack, and defense. The echelons for which TSPs were developed included armor and mechanized infantry platoons, armor and mechanized infantry company teams, and armor battalion task forces. Only one task force TSP was developed for the movement to contact mission. These TSPs supported operational testing and initial fielding of the CCTT at Fort Hood, Texas in 1998.

During the follow-on STRUCCTT-2 project, an AFRU contractor team developed TSPs for a task force defense exercise, for 12 cavalry troop and subordinate scout platoon exercises, for three sets of CCTT orientation exercises, and for four M1A2 tank platoon exercises. The team developed all exercises, except those for the M1A2 platoons, for conventional units without digital equipment. Units and CCTT site personnel use the TSPs developed under both STRUCCTT projects to support training on a regular basis, with the heaviest use in the first CCTT site at Fort Hood, TX. The methodology used in, and lessons learned from, the STRUCCTT projects have been documented in ARI reports. (For example, see ARI Research Report 1727, *"Structured Training for Units in the Close Combat Tactical Trainer: Design, Development, and Lessons Learned"*).

The development of TSPs for the CCTT required several methodological expansions and innovations beyond the initial SIMNET TSPs for the VTP. The CCTT is a more complete simulation than SIMNET, with many interacting parts to synchronize in the TSP for a structured exercise. These parts include SAF, CS, CSS, and AAR workstations and their operators. The CCTT TSPs present specific guidance for incorporation of these workstations in structured exercises. Also, dedicated trainers or observer/controllers (O/Cs) are not provided to conduct CCTT exercises as they are in the VTP. The CCTT TSPs thus have extensive train-the-trainer materials that guide unit leaders to perform O/C and other training duties.

Commanders' Integrated Training Tool (CITT)

The 60 TSPs created in the STRUCCTT projects do not represent the full set needed for CCTT exercises. Unit leaders frequently see a need to modify the STRUCCTT TSPs, or to develop new ones to support particular training needs identified



in the unit's Mission-Essential Task List and the results of previous trainingexercises. Recognition of this need has led to a second series of ARI AFRU projects sponsored by PM and TSM CATT to develop a CITT for the CCTT.

The CITT software is designed to provide commanders and other unit trainers ready access to all the information they need to exploit the capabilities of the CCTT. It includes modules providing detailed information about CCTT components and capabilities, as well as about the structured approach to CCTT training. It also provides guidance on selecting and modifying existing TSPs, along with methods for developing new ones. The CITT serves as an integrated gateway to available information on training with the CCTT, with versions designed to be available in both stand-alone (desktop computer with CD-ROM) and distributed (World Wide Web) modes.

During the initial CITT project completed in December 1998, an AFRU contractor team designed a complete CITT and developed a prototype for limited formative evaluation. The team also produced two videotapes providing instructional overviews on how to train with the CCTT, based on the same information presented in CITT. After successful completion of the initial CITT project, a continuation CITT-2 project recently began that will expand the initial CITT design in several regards. This includes the development of TSPs for digitally equipped units, and TSPs for new terrain databases other than the National Training Center for which the initial set was developed. The CITT Team is currently developing a second-generation CITT prototype for expanded formative evaluation during the summer and fall of 1999.

The CITT is designed as a future module of the Standard Army Training System (SATS), a software package currently evolving to aid commanders in developing and managing their unit and individual training programs. Once commanders make the decision through SATS to accomplish specific training requirements in the CCTT, they will access CITT to plan and prepare for their training. The CITT-2 design will expand this capability to the point that commanders can develop simulation initialization files in CITT and transfer them electronically to the CCTT site. The CITT should thus facilitate greatly units' use of the CCTT. Internet access to the current version of the prototype CITT is available at the following website address: http://www.cittcctt.org.

Conclusion

While the STRUCCTT projects produced an extensive set of TSPs for the CCTT, resources will not be available for centralized production of all CCTT TSPs needed. The CITT enables unit trainers to access available TSPs along with methods and tools for developing their own. Ultimately, use of CITT should result in a large library of TSPs for CCTT exercises. Issues relating to how to manage and sustain such a library remain subjects for research and development.

The CITT is a prototype of the integrated training development system needed for future simulations. Ultimately, SATS should incorporate CITT-like tools for all major training devices and simulations. This will enable trainers to gain access to (and provide input to) available guidance and lessons learned in order to more fully exploit available training systems.

For additional information, please contact Dr. Billy L. Burnside or Dr. David W. Bessemer, ARI- Armored Forces Research Unit at Fort Knox.

If you have any questions or comments on this report, please contact the ARI Webmaster at webmaster@ari.army.mil

Information Technology and Battle Command: Lessons from Management Science and Business

All organizations, including military units, are a union of psychological, social, cultural, political, and economic subsystems - all aspects of the human dimension. Each of these subsystems varies in its ability to adjust quickly to new technology. The "lessons" in this report can serve as a starting point in the need to understand and accommodate the human dimensions of digitization, to include training and leader development.

In the May 26, 1999 issue of Army Times, G.C. Wilson discussed the "failure" of Army digitization efforts to achieve improvements in operational capabilities. Given what we have learned from business' attempts to apply emerging information technology, this comment is not really surprising. We know from civilian commercial organizational experience that it is simply too early in the Army's digitization process to expect to see information technology contribute to quantum improvements in operational capabilities.

There may be a great deal of political support to digitize the Army as quickly as possible. However, it normally takes from six to ten years for a major system purchase, such as a major command system, to enter the budgeting cycle and work through the materiel acquisition process. In this example, it is not clear which subsystem will prevail - the political or the economic.

A Literature Review

The sheer number of complex interrelationships that need to be considered and the length of time it may take to see effects of information technology on bottom line performance are only a few of the many insights and findings gleaned from a recent review of the literature (by ARI). The literature review was performed with a search of electronic databases of management science and business literature for insights into the effects of digitization. These databases include over 800 different professional journals as well as related books and other reference material. Over 700 separate articles from 1985 onward were identified and summarily reviewed that related to the topics at hand. The goal of the review was to provide some "fresh" insights into our understanding of the human dimension of information technology and the digitization process.

Findings

Despite the large number of experiments conducted and research reported in the management science and business literature, very few "hard and fast" lessons pertaining to the effects of information technology could be developed. This is due primarily to conflicting findings and different experimental designs.

However, this "non-finding" is actually a finding, in the sense that it underscores the inability to precisely predict the effects of information technology at the organizational, group, and individual levels, and the risks inherent in bringing new technology into these levels. The generalizations that can be made because of the review, such as the importance of training; the success of the insertion effort; and, the necessity for top leadership support throughout the insertion process, are documented in the report and are arranged by level of analysis—organization, group, and individual.

Based on the information gained from the literature review, we speculate that current digitization efforts will result in future Army organizations best described along a continuum, ranging from Digitized Mechanistic at one extreme, to Digitized Organic at the other, an idea adapted from Burns and Stalke's 1961 (Table 1) Book, adaptive Organizations are an intermediate point on the continuum of organizational structures and behaviors. The following is an explanation of the three ideas.

Digitized Mechanistic Organizations tend to be highly specified, specialized, centralized, standardized, and relatively closed. They are most effective when processes are routine and in stable environments. Information technology contributes to stability and control.

Digitized Organic Organizations, in contrast, tend to have low degrees of specification, formalization, centralization, routinization, and closedness. They

are most effective when processes require problem solving and when the environment is uncertain. Information technology contributes to sampling the environment and adapting to it.

The Digital Adaptive Organization proposed is a type of organization that can reflect the characteristics of either a Digital Mechanistic or a Digital Organic Organization, depending on the technological and social environment in which it operates. The Digital Adaptive Organization is mechanistic or organic depending on the contingencies reflected in METT-T (mission, enemy, troops, terrain, and available time). This type of organization tailors the capability of the information technology to automate routine functions, and applies information technology to those functions requiring a focus on knowledge and learning.

Table 1. Nature of Command and Organizational Types - A speculative adaptation of the Burns and Stalker (1961) model crossed against command characteristics and imperatives (as given in FM 100-5 [Draft])

Command: Characteristics & Imperatives	Digitized Mechanistic	Digitized Adaptive	Digitized Organic
Leadership	• Based on position • Appointed • Centralized (concentrated at top) • Emphasis on stability and control	**Contingency dependent based on factors such as:** **Type of unit (e.g., infantry, signal, and transportation)** **Organizational Level** **Type of mission** **Commander's leadership style**	• Based on knowledge • Emerges • Location varies by task • Emphasizes change and learning
Professional Knowledge	• Narrow / Specialized - "Science" • Emphasis on procedures • Limited requirements for continuing education		• Broad / Generalized - "Art" • Emphasis on openness • Constant requirement for continuous education.
Vision & Intellect	• Linear - objective reality • Limited range of options • Next higher HQ goals / vision • Maximization of organizational interests • Emphasis on plan and planning		• Parallel, exchange, change • Maximal range of options • Own organizational goals • Maximization of self interest • Emphasis on creativity and originality
Judgment & Initiative	• Constrained by organizational structure and plan		• Constrained by group consensus
Courage & Resolve	• Courage and resolve to execute directed task ("Watch your lane")		• Courage and resolve to do the right thing
Self- Confidence	• Confidence in reliance on system		• Confidence to facilitate a learning environment
Ability to Communicate	• Vertical • Fixed media		• Multi-directional • Multimedia
Integrity & Example	• Faithfully replicate orders and information received • Faithfully execute orders received		• Faithfully communicate personal best view / opinion • Do what you think best
Teamwork	• Hardware and software forms the basis of the team • Team operates system and is monitored by system • Inflexibility in team functions		• Information / knowledge forms the basis of the team • Team is in constant learning mode • Flexible functions
Common Doctrine & Training Standards	• Prescriptive		• Ephemeral
Control	• Obtrusive • Situational • Professional • Process oriented		• Unobtrusive • Personal • Paternalistic • Output oriented
Delegation of Authority	• Centralized planing and execution - minimal		• Decentralized planing and execution - maximal
Allocation of Resources	• Centralized allocation		• Competition
Timely Decisions & Actions	• Depends on layers		• Depends on consensus

Each organizational type, Mechanistic, Adaptive, or Organic, presents a unique set of opportunities, demands, and constraints on commanders and staff operating within them. In Table 1, we compare and contrast the nature of command using fourteen characteristics over the range of organization structures and behaviors just described.

New information technology within the Army will inevitably require commanders and staff to develop additional competencies. Nine new competencies, hypothesized to be required of commanders and their staffs, given the potential impact of new information technologies, are:

- Ability to identify and adjust to information technology requirements.
- Ability to quickly master individual and collective learning requirements.
- Ability to acquire tacit (how to) knowledge as well as explicit (what) knowledge.
- Ability to master conceptual as well as mechanical aspects of command and control.
- Ability to define information requirements and appropriate information filters.
- Ability to formulate and execute information search strategies.
- Ability to manage decision context as well as to make decisions.
- Ability to delegate as a function of decision context.
- Ability to sustain all current (analog) commander and staff competencies.

Conclusion

The "lessons" and subsequent discussion contained in the Dodge et al. (1999) report and summarized in this article can serve as a starting point in the need to understand and accommodate the human dimensions of digitization, to include training and leader development. Further, theoretical organizational types depicted in the report can be of use by force designer as they create new organizational design concepts for future digitized units.

For further information, please contact Dr. Richard E. Christ, ARI- Scientific Coordination Office, Fort

If you have any questions or comments on this report, please contact the ARI Webmaster at webmaster@ari.army.mil

Training to Think Critically on the Battlefield

ARI research showed that training critical thinking skills could improve Army tactical planning performance. A system for training critical thinking skills was designed and implemented on a CD-ROM, which students at ther Army Command and General Staff College (CGSC) used as part of their course work. Preliminary evalution results of the training at CGSC showed a significant improvement in tactival planning performance in the group that received the training over a control group that did not receive the training.

Army training through doctrine, classroom instruction, and training exercises traditionally focuses on the training of knowledge and procedures (e.g. using The Military Decision Making Process). However, both naturalistic psychology and studies of actual field performance suggest that use of procedural steps and rigid decision rules may not be the way proficient tactical planners perform. Research shows that they use a variety of strategies and thinking skills to short cut the procedures. One way to augment the effects of traditional procedural training is by improving the critical thinking skills that are used to execute those procedures. The Fort Leavenworth Research Unit of ARI is conducting a program of research to identify and train thinking skills that will enhance Army tactical planning performance on the battlefield. A variety of training methods and tools to support the development of these skills is being developed along with methods and measures to predict and diagnose the skills.

As part of this research program, ARI has sponsored the development and evaluation of a training system for critical thinking skills that supports procedures in the Military Decision Making Process. The training system was developed by Cognitive Technologies, Inc. and is implemented in a CD-ROM.

Training to Think Critically on the Battlefield: Development of A Training System

This training aims to improve the ability of Army tactical staff officers to quickly grasp the essential elements of a complex, uncertain, and dynamic situation, visualize those elements in terms of their units' goals, and take action in a timely and decisive manner. Such skills are highly valued in war-fighting scenarios that require U.S. forces to use flexibility, speed, and maneuver to overcome a numerically superior threat, and they will remain critical as our forces use shrinking resources in regional conflicts and carry out delicate operations other than war.

To accomplish these aims, four critical thinking skills were chosen for implementation in the training CD. The first skill is keeping the goal of the mission upper most in mind and having it drive all aspects of planning, This involves constructing a mental model or picture that ties together of all elements of the battlefield situation. The second skill is time orientation - knowing when and how to be proactive, predictive, and reactive in planning and how to turn predictive courses of action into proactive courses of action, or reactive into predictive courses of action. Figure 1 shows an example screen display from this part of the training. It illustrates critical thinking and introduces the notion of proactive and predictive time orientations with a simple map example. The third skill is identifying problems in your mental model and then correcting them. Problems to look for include unreliable assumptions, important information that is missing, and conflicts between information sources, tasks, or purposes.

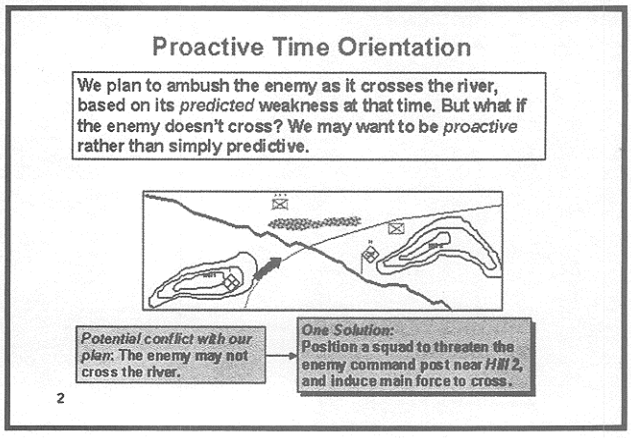


Figure 1

The fourth skill involves challenging your plan to see how and why it might fail even if you are certain it will succeed, and then changing the plan to deal with originally unaccounted for factors.

The skills to be trained and training methods were based on an original theory of proficient decision making, this theory addresses in detail how experts differ from novices both in the way they organize their knowledge, and in the strategies they use to apply their knowledge.

More specifically, the four critical thinking skills were derived from, and Army training needs were identified by using: (1) past theoretical and empirical work on mental models, expert-novice differences in problem solving, and studies of meta-cognitive processes in attention, memory, and behavioral decision making; (2) thirty-two individual critical incident interviews and think aloud problem solving sessions with field grade officers; (3) interviews with Army CGSC instructors and an Army General Officer (Ret); and, (4) observation of CGSC classroom instruction.

The digitized training system includes structured instruction, historical examples, guided practice using practical scenarios and training exercises, detailed feedback to students, and performance measures. It is accessible either through CD-ROM, or over the World Wide Web, and is suitable for classroom instruction, training in the field, or distance learning. Commercial companies and other military agencies, including the Navel Air Warfare Center/ Training Systems Division, have expressed a strong interest in using the training technology developed in this project to create advanced systems for training and supporting decision makers.

Evaluation of the Training System

Four sections of a CGSC course in advanced tactical planning participated in the evaluation of the training system. It was evaluated using experimental and control groups and a pretest/posttest design. Since students could not be randomly assigned to course sections (i.e. treatment and control groups), the evaluation design was quasi-experimental.

Two sections served as treatment groups, receiving the training as a self-administered individual homework assignment. Class discussion, led by section instructors, followed the assignment. Two course sections served as control groups and did not receive the training or the section discussions concerning it. All participants received a scenario-based pretest at the beginning of the course and a posttest at the end of the course. The two scenarios

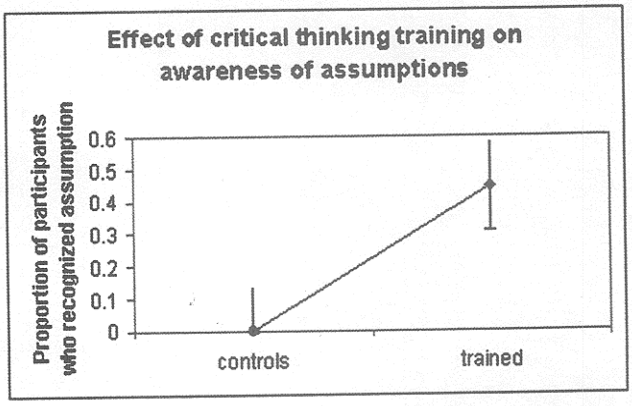


Figure 2

used in the pre and post tests were counter balanced between the pre and past-tests within treatment conditions. The evaluation tested hypotheses concerning the effects of training on overall tactical planning skill as well as on the four specifically trained skills.

A preliminary analysis of the evaluation data collected at CGSC suggests that use of the training CD will improve critical thinking skills and battle command performance. There was a statistically significant effect of critical thinking training on the ability of students to recognize the assumptions underlying possible courses of action. For example, in one test scenario, students who did not receive the training failed to recognize the hidden assumptions underlying an attractive offensive opportunity, in particular, that it would jeopardize their primary mission of guarding the higher unit's flank. But almost half the students who received critical thinking training did recognize this assumption (Figure 2). Moreover, they explicitly took it into account in their

decisions. Students who received the training were less likely to risk "getting bogged down" in a risky offensive that was not essential to the mission (Figure 3).

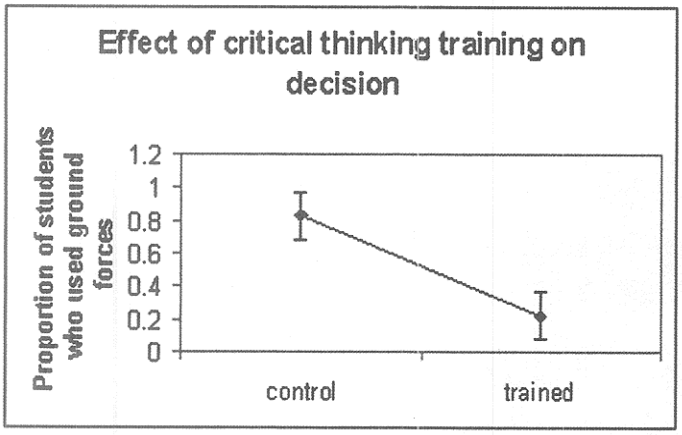


Figure 3.

Subjective evaluations of the training by CGSC students were largely positive, with about 70% of the students finding it valuable or extremely valuable, despite the limited interactive capabilities of the initial version of the training.

1999 Army Award for Excellence

The ARI project received an Army SBIR Phase II Quality Award as one of the top five Army SBIR projects in FY 1999. The award is based on originality and innovation of the research, relevance to the Army and its mission, and achievements of the project.

Conclusion

Initial evaluation results of the training system described here suggest that training critical thinking skills can result in improved tactical planning performance. However, research in this area is still in preliminary stages with many basic questions still to be addressed. Among these are: Which critical thinking skills should be selected for training and how do we choose? Can such skills be trained or are they innate? How should these skills be measured? What training methods are the most effective? How should the training be evaluated? Does the training of thinking skills make any difference in battle command performance? If there are training effects in performance, are they long lasting? Are thinking skills used in battle command best taught in the context of battle command tasks or are they best taught as general skills applicable over different many content areas? On-going research at ARI is addressing many of these questions.

This research provided an apportunity to apply and test an approach to study command decision behavior. An instrument called the Critical Decision Inventory (CDI) was used. The research methods that were tested in the evaluation of this tool will be useful in the pursuit of new research directions.

For further information, please contact Dr. Sharon Riedel, U.S. Army Research Institute Fort Leavenworth Research Unit, Fort Leavenworth,

"Did you know that..."

Soldier Demographics[1]

- *66.3% of enlisted personnel (PV2-CSM) and 30.8% of officers (2LT-COL, WO1-CW5) are less than 30 years old?*
- *90.3% of officers (2LT-COL, WO1-CW5) have completed at least a bachelor's degree?*
- *27.7% of officers have a masters degree and another 8.7% have an advanced professional or doctorate degree?*
- *59.0% of enlisted personnel have completed at least 1-2 years of college (and 6.7% have a bachelor's or higher college degree)?*
- *of those who reported their race/ethnicity, 15.4% of enlisted personnel and 5.9% of officers report that they are of Hispanic/Spanish origin or ancestry (of any race)? [NOTE: Official Army personnel records indicate 8.4% of enlisted personnel and 4.0% of officers are reported to be of Hispanic/Spanish origin or ancestry (of any race).]*

[1] *Results from the Spring 1999 Sample Survey of Military Personnel, conducted by the Army Personnel Survey Office (ari-apso@ari.army.mil). 30 Aug 99*

"Did you know that..."

Army Families[1]

- *75.3% of officers (2LT-COL, WO1-CW5) and 59.3% of enlisted personnel (PV2-CSM) are married? [NOTE: Official data on family matters is available through DEERS; Source is the Family Demographics Database. Contact Tim Whyte, US Army Community & Family Support Center, ATTN: CFSC-SP, 703-681-7425.]*
- *18.6% of officers and 33.6% of enlisted personnel are single and have never been married?*
- *90.9% of officers and 82.8% of enlisted personnel report their spouses are currently with them at the CONUS or OCONUS locations.*
- *55.2% of the civilian spouses of enlisted personnel are working (either full-time or part-time), 27.3% want to work but don't have a job now, and 17.5% report that they do not want to work now?*
- *50.5% of the civilian spouses of officers are working (either full-time or part-time), 18.7% want to work but don't have a job now, and 30.8% report they do not want to work now?*
- *approximately 58% of officers and 50% of enlisted personnel have a child of any age who is currently dependent on the soldier (for over half of the child's support)?*
- *of those with dependent children, 76.5% of officers and 73.0% of enlisted personnel have a child 12 years old or younger who is currently living with them?*

Deployments[1]

- *32.9% of enlisted personnel (PV2-CSM) and 14.0% of officers (2LT-COL, WO1-CW5) reported that they had not been away from their duty station for their military duties (including deployments, assignments, training, TDY) during the last 12 months; another 7.6% of enlisted personnel and 8.1% of officers reported they had been away for less than one week?*

Soldiers' Units[2]

- *25.8% of officers (2LT-COL, WO1-CW5) and 12.6% of enlisted personnel (PV2-CSM) work in units where at least half of the work group are federal civilian employees?*
- *28.3% of officers and 22.5% of enlisted personnel work in units where at least half of the work group are females?*

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1 *Results from the Spring 1999 Sample Survey of Military Personnel, conducted by the Army Personnel Survey Office (ari-apso@ari.army.mil). 30 Aug 99*

2 *Results from the Fall 1997 Sample Survey of Military Personnel, conducted by the Army Personnel Survey Office (ari-apso@ari.army.mil). 20 Aug 98*

New Ways of Measuring Battle Command

How commanders and staff think is extremely important to a unit success. Unfortunately, the measures of command and staff performance are not very straightforward. Finding a useful way to measure command and staff performance has been an elusive target for researchers and trainers over the years. But the benefits are clear-cut. Wisdom suggests that all evaluation is training and all training is evaluation. Without evaluation there can be little feedback, and without feedback, training value is not guaranteed. Without some kind of assessment, a training exercise is just another experience that the commander and staff share.

In order to better understand how commanders and staff officers think, ARI teamed up with the US Army Research Laboratory (ARL) and the Battle Command Battle Laboratory. They studied the human decision process in a Prairie Warrior exercise in May 1998. ARI and ARL pursued this work through a joint research agreement, called the Cognitive Engineering of the Digital Battlefield. This program of research is formalized and approved as a Scientific Technical Objective (STO). The program aims to determine what the key cognitive phenomena are that should influence information technology designs and education and training practices.

The purpose of observation in this exercise was to record cognitive phenomena systematically, as they occur in settings suggestive of future conditions. From a scientific viewpoint, the exercise provided an opportunity to apply and test an approach to studying command decision behavior. ARL initiated development of an instrument called the Critical Decision Inventory (CDI).

CDI has multiple parts. It is a guide for an observer to record the decision event (such as deciding to commit reserves to the main attack), how long deciding took, whether there were any underlying and prevailing themes that shaped the decision (e.g., force protection or maintain flexibility), the mental activities of the human decision process (e.g., visualization, problem decomposition), the nature of interaction between the commander and staff, critical information elements, cognitive workload estimate, and the effectiveness of the functional support provided by digital information systems. ARI was principally involved in the design of three parts of the CDI: decision events, themes, and mental activities.

The use of the CDI followed a three-step method: First, observers familiar with command and staff operations continually monitored and kept notes on behaviors they observed. Next, the CDI data forms were completed based on the observations and notes

taken. Finally, the observations recorded on the CDI forms were confirmed with key command and staff participants to check the observer's notes and provide elaboration. This last step is a departure from usual command and control observation and study. Usually researchers try to avoid any intrusion into an event so as not to alter the behavior of those involved. In this application of the CDI, direct interviews were confined to non-busy periods or the end of the day. This time served as an opportunity for the researchers to directly ask questions of the key command group members about what would otherwise have to be the observer's guess (e.g., how familiar were you with this situation?).

Lessons Learned about CDI

This confirmatory function of the CDI worked very well. It provided a perspective that was not

illuminated in previous studies in this area (for a summary of relevant studies see Human Dimensions of Battle Command, Halpin (Ed.), in publication). The following lessons were learned about the CDI and its implementation:

• *Decision events are difficult to isolate.* They tend to occur as evolving, overlapping episodes rather than discrete events. Event definition is an art unto itself. It is largely a matter of personal construction to determine how one thing is separate or like another. More work is needed to find better ways to define decision events and their relationships with other decision events. Observers can become better at identifying events, but will often lack the complexity of thought of the actively learning commander.

• *A more systematic way is needed to manage the limited amount of time to speak with the participants.* Interview time with students was limited. In order to use the available time wisely, observations that need to be confirmed were limited to the most important. As a result, the reliability of the whole set of observations may have been diminished.

• *To prevent one individual from becoming biased by listening to what others recalled, opinions from individuals should be sought prior to group discussion.* This is because the end-of-day confirmation sessions were typically run as a group session.

• *Themes tended to fall into one of two categories: bold action or force protection.* Which of the two was more prominent seemed to hinge on the command and staff's perception of whether friendly forces held the initiative or not. More conceptual work should be done on themes to identify additional ones, their strengths, and their inter-relationships.

Observations of Commander and Staff

As useful as insights into the method were, the most interesting findings came from the observation of the commander and staff. These findings corresponded to earlier observations (e.g. Fallesen, 1993, ARI TR1037), but were useful nonetheless by providing deeper insight, especially concerning operations in a simulated digital command post. A subset of observations follows:

• There was a concern about failure to synchronize actions among brigade, division, and corps echelons when the main effort of the division was shifted to a contingency route. Shifting combat power occurred to exploit success, but the consequences on forces up and down echelons were not projected in detail. For example, there was no allowance made for early or late arrival of forces at the main battle area and no backward planning to identify necessary movement times for supporting forces. ARL-ARI concluded that synchronization is a function ripe for better decision tools, and that tactical training should emphasize coordination on the dynamic aspects of force movement.

• The commander and staff put considerable effort into imagining how best to fight the decisive battle, but there was no closure nor any clear decisions made about which way to prosecute the battle at the division. The discussions continued at the headquarters even while the (simulated) frontline units were setting and, in some cases, even after they were engaged. Again, information tools could help manage the war gaming sessions and guide them to closure. Training could help guide better ways to choose what is important to think about and encourage decisive thinking.

• The digital division often had a faster and more accurate picture of the battlefield from its intelligence processing than did corps. The digital to analog difference caused some conflict between the two command posts, one echelon distrusting the other's situation understanding. It took a long time for the players to understand that the difference was an information delivery issue and not an issue of either staff's ability. The need for trust and cohesion will be even greater as future units operate in a more dispersed mode. One remedy will be to impart a clear systems understanding under all operating conditions of the different command posts.

Improvements in Training

Observations during the week of training also led to some insights about opportunities for improvement in training.

1. Students could benefit from a dry run of staff planning and execution procedures, similar to the style of a first read-through of a script by a theater cast. Each staff member could talk through what they would do, and what coordination should occur with others. If they could enter the exercise with a better understanding of their roles and of the group process, they could get more time practicing what they are to be trained in.

2. The amount of instruction on the procedural aspects of the battle command and staff process was low for an Army that wants to pride itself on becoming a learning organization. The observer/controllers and mentors for the exercise interacted with students at the end of a day and used it as an opportunity to address tactical or administrative issues. This objective suggests a shift to put more focus in the practice of command and staff functions, instead of toward the fight or preparations for actual (simulated) battles.

3. Methods need to be found to accelerate the shift of student's thinking at the comfort level of technical and tactical to one of commanding and controlling large unit operations. For example, their failure to estimate movement times seemed largely to be a matter of relying on past habits that they used to think at the company and battalion levels (execution over prediction and planning).

The inventory approach was successful but required observers who were trained in behavioral science and had considerable knowledge in battle command operations. The approach went beyond most previous research, confirming the scientists' observations by asking the training audience directly about identifying reasons why decisions were made, and why behaviors occurred. To make the approach work the scientists had to make a large investment in time, observing nearly the entire duration of the training sessions and to remain open-minded about what was happening and why. Both of these characteristics contrast with typical observer/controller behavior at division or corps level, who rotate among several locations and are tasked to confirm or deny specific issues.

The research methods tried out in the Prairie Warrior exercise will be useful in the pursuit of three research directions. These observations closely mirror those that have been identified before and that helped ARI define its current three-part research program on developing conceptual thinking. This on-going research addresses which critical thinking skills are

best to teach, how to reach higher performance by increased awareness during training, and how to understand and improve one's own style of learning.

For additional information, please contact Dr. Jon Fallesen, ARI Fort Leavenworth, [redacted]

If you have any questions or comments on this report, please contact the ARI Webmaster at webmaster@ari.army.mil

Emotional Intelligence, Stressful Events and Traffic Accident Risk:

Is Going for A Drive to Calm Down a Good Idea?

ARI compared high and low risk drivers across a variety of measures (e.g., general aptitude, personality, motor skills), and evaluated the impact on safe driving of situational events (e.g., stress, weather, road conditions). The data reveal that a driver's emotional state dramatically alters the probability of being involved in an accident.

These data are important because driver education classes and traffic safety briefings rarely address emotional factors. ARI hopes that disseminating this information will help soldiers better appreciate the impact of their emotions on safety and drive more responsibly.

The answer is clear: 'No! Don't go for a drive to calm down!.'

Overview

Driver safety is a concern to the Army because traffic accidents result in over 120 soldier fatalities and 1,200 injuries each year. At TRADOC's request, ARI designed a study to improve driver safety by:

(1) identifying information and procedures to reduce POV accidents and fatalities, and
(2) providing guidance to help leaders assign drivers for military vehicles.

This article describes information that may improve POV safety by helping drivers respond appropriately to everyday driving hazards.

To improve POV safety, ARI investigated the possibility that safer drivers are better at assessing the risks associated with everyday driving hazards. We reasoned that if we could establish a link between perceived risk and accident involvement, then we could identify some of the information used by better (safer) drivers to avoid accidents. We expected that this information could be used to develop safety messages and decrease accident rates.

Driving Knowledge Tests

ARI developed two driving knowledge tests that measured how well individuals could estimate the danger associated with a variety driving conditions. These tests are tacit knowledge scales and are unusual because they tap knowledge that is typically gained through experience but could be taught. Our expectation was that accident-prone (high-risk) drivers tend to either over or underestimate the danger associated with specific driving hazards and that this tendency leads to risky driving behavior. We identified safer (low-risk) and accident-involved (high-risk) drivers by using U.S. Army Safety Center (USASC) data and self-report questionnaires.

Safe Speed Knowledge Test. The Safe Speed Knowledge test required individuals to indicate the extent to which drivers should slow down given a variety of common road hazards. Road hazards included environmental conditions, such as rain or snow, as well as emotional or internal factors, such as stress due to family problems or an illness such as a head cold. The emotional/internal items were based on theories of emotional intelligence that suggest performance in many domains is limited by the ability of individuals to understand and respond appropriately to adverse emotional or internal states, such as being stressed, angered or fatigued. We also collected data for a number of standard measures (e.g., general aptitude, spatial aptitude and personality), however, the most important results were obtained for the internal/emotional items on the Safe Speed Knowledge Test.

Accident Causation Test. The Accident Causation Test asked individuals to estimate the percentage of major accidents that involved 14 conditions. These conditions referenced a variety of environmental factors, e.g., road conditions and weather, as well as

several characteristics specific to the driver, e.g., alcohol-use, age and stress. One typical question asked individuals to "estimate the percentage of major accidents that involved drunk drivers".

Research Design

The tacit knowledge scales were administered to 400 soldiers. We used USASC records to identify one-third of our participants who had been involved in major accidents. The remaining two-thirds of the participants were of similar age, but had not been involved in accidents reported to USASC.

All the participants completed a self-report information survey to describe traffic accidents in which they were involved in the preceding five years. The survey data were used to estimate for each individual the:

(1) Total number of at-fault accidents,
(2) Total number of accidents,
(3) Total cost per accident

We validated the tacit knowledge scales by correlating them with the accident measures. We then analyzed the subject's responses for each item to identify types of factors that safe drivers consider.

Results

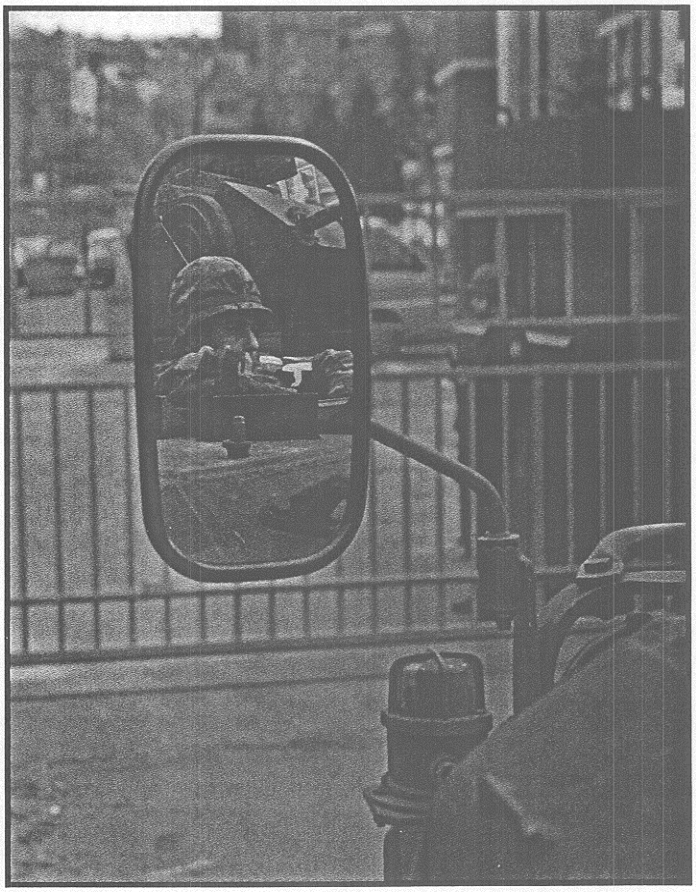
Safe Speed Knowledge Test. The correlations between poor performance on the Safe Speed Knowledge Test and the accident criteria were substantial and compared favorably in magnitude to correlations typically obtained in traffic accident research. In general the analyses show that individuals who performed poorly on the test had more accidents. The data show that individuals with test scores in the:

- Lowest 20 percent had 5 times as many accidents as the baseline group.
- Middle 60 percent had 2.3 times as many accidents as the baseline group.
- Top 20 percent had the lowest accident rates and constituted the baseline group.

Factors Poor Drivers Ignore

To better understand the results obtained for the Safe Speed Knowledge Test, we correlated the individual test items with the accident criteria. The highest correlations were obtained for those items that contained an emotional component.

The responses for the emotional test items showed that a substantial proportion of the participants ignores emotional/internal factors when driving. It may be alarmingly that 15 percent of our sample indicated that a moderation in speed was not necessary to maintain safety during periods of stress, fatigue or illness.



The best drivers indicated that individuals should slow down moderately in response to internal/ emotional states such as illness, anger or stress. In contrast, high-risk drivers provided more extreme responses and tended to indicate that drivers should either slow down dramatically or not at all when ill, angered or stressed.

Stress and Emotion

It is apparent that these results indicate that Army safety messages should emphasize the importance of appropriately moderating driving speed and style in response to adverse environmental conditions as well as one's emotional frame of mind. It is also important to recognize that some individuals have trouble identifying the emotional states during which accidents are more likely to occur. We expect that these individuals would benefit from

(1) suggestions and examples of events associated with stress or other emotional extremes.
(2) Encouraging peers and family members to help drivers recognize periods during which he/she may be less vigilant.

Accident Causation Test. Performance on the Accident Causation Knowledge test was not generally correlated with accident involvement. However we found that 15 percent of the participants believed that all major accidents involve "drunk drivers", and that 52 percent believed that at least three-quarters involve drunk drivers. These estimates contrast sharply with U.S. Department of Transportation data indicating that about four-tenths of fatalities are alcohol-related.

It was unexpected that so many individuals would view alcohol as the leading cause of most major accidents. We believe that this distribution reflects the emphasis attached to alcohol in public service messages and Army safety briefings. While it is beneficial that many drivers are aware of the dangers associated with alcohol, the disturbing possibility exists that some individuals may assume they are safe to drive provided they have not consumed alcohol. It is reasonable that these individuals might benefit from training emphasizing the potentially dangerous impact of emotions on driving safety..

Practical Implications

The results indicate that to reduce POV and military vehicle fatalities and accidents, Army training and policy should emphasize these themes:

- Being sober does not ensure safety. Explain that while drinking and driving is a lethal combination (involved in 40 percent of American driving fatalities), other events may conspire and result in accidents or fatalities.

- Don't over react, but react as needed. Educate drivers to moderate their speed and driving style in proportion to the severity of environmental hazards and in response to the internal/emotional state of the driver.

- Going for a drive to calm down is not a good idea. Emphasize that accident risk is increased by stressful events such as marital or financial troubles and highlight the importance of monitoring, identifying and controlling one's reactions to these events.

- Passengers should be careful to not distract their drivers. Encourage peers and family to help stressed-individuals recognize their emotional state and act appropriately

For additional information, please contact Dr. Peter Legree,

If you have any questions or comments on this report, please contact the ARI Webmaster at webmaster@ari.army.mil

CURRENT PUBLICATIONS OF SPECIAL INTEREST

The following are currently available publications from ARI that may not be available on the public Website

Operation Joint Endeavor Research Project Final Report

Army planners can use the findings from the Operation Joint Endeavor Research Project Final Report (Special Report 38) as a tool as they cope with the challenges of future deployments. The focus of this research was soldier and family attitudes about their OJE experiences. Through surveys and interviews, soldiers provided their opinions about preparation, leaders, work, quality of life, and impact of their OJE deployment. Spouses provided their opinions about the Army's support for families, and family support for the mission.

AC soldiers felt they were well prepared for their deployment to Bosnia, and were generally satisfied with many quality of life factors. They saw positive consequences of the deployment in terms of their financial situation, future promotion, and civilian job/career. However, they saw negative consequences for their children, their marriage and the likelihood of volunteering for a similar operation. Many questioned why they were required to perform tasks that were not part of their Military Occupational Specialty (MOS). Some also felt they needed more culture-specific preparation. RC soldiers as a whole felt more prepared for serving as backfill in Germany, and were generally satisfied with the quality of life in Germany. The one major problem they cited was not feeling respected or treated as equals to the AC.

Spouses of Germany-based soldiers who were deployed to the Bosnia region relied heavily on Army family support services, and generally gave high marks to the services they used. They said that their soldiers were well prepared, but were not very supportive of Army participation in OJE.

Many of these issues were salient in previous deployments, and likely will re-emerge in future deployments. This research gives Army planners and leaders an awareness of the areas of success and the areas needing improvement for future deployments.

U.S. Army Research Institute Products Developed From 1985-1998 for the Reserve Component

Two recent ARI publications present work performed by ARI's Reserve Component Training Research Unit. Special Report 32 summarizes selected research and development (R&D) products produced between 1985 and 1998 for the Army's Reserve Component (RC). The product summaries cover the areas of individual, crew, unit, and battle staff training, distance learning, personnel turbulence, and deployments, and how these issues relate to RC operational readiness constraints. The other publication (Research Product 98-38) is a more detailed catalog of RC-oriented R&D products. This catalog contains seven chapters, first describing the RC operational environment, then focusing on a range of R&D products using training aids, devices, simulators and simulations (TADSS). It also deals with issues of geographical dispersion, RC attrition, and peacekeeping deployments. In providing this information, we hope to reveal not only what ARI has done up until now, but also the scope of what it is capable of doing in the future, to support RC R&D product needs of the 21st Century.

ARI's Contributions to the All-Volunteer Force

Before 1973, the draft ensured an ample supply of military manpower. With the onset of the All-Volunteer Force (AVF) Special Report xx, the Army had to learn how to attract and keep quality soldiers. At the same time, it had to be sensitive to the growing diversity of the force.

In the 25 years during which ARI has been serving the volunteer Army, its research scientists have worked on hundreds of projects covering an immense

range of subjects. ARI's long-term program in support of the All-Volunteer Force can be grouped into five major areas: Recruitment, Selection and Classification, Training, Retention and Transition, and Personnel Management. For example, understanding what motivates quality youth to enlist is an ongoing area of inquiry. So too is listening to the attitudes, opinions, and concerns of those already in uniform in order to promote equal opportunity, job satisfaction, retention, cohesion, and readiness. Through decades of research work on Army concerns, ARI has helped to develop, and continues to help maintain, qualified and ready volunteers for the modern Army.

A brochure describing ARI's contributions to the All-Volunteer Force is available from the ARI Marketing Office.

See You On The Objective: ARI Program NIGHTFIGHTER

How does the Army cope with combat tasks at night and in the dark?? ARI Special Report 37 summarizes seven years of work from NIGHTFIGHTER, the Army Research Institute's (ARI) research program on night operations training. ARI initiated the program about one year prior to the Chief of Staff's challenge to assess the statement that "We own the night." An initial analysis of night fighting in 1992 and 1993 found that soldiers from units and personnel from the Joint Readiness Training Center consistently identified certain combat tasks as problems at night. The analysis also identified significant training deficiencies and voids. This report describes a series of experiments and research products aimed at reducing those deficiencies, such as the enhanced use of night vision goggles and aiming lights, and a program to train soldiers on the thermal signatures of combat vehicles. Also included is research on an unaided night vision training program and the development of train-the-trainer materials for the deliberate night attack. A recently completed follow-up analysis determined to what extent the earlier night combat problems have been reduced since the Army's own-the-night effort began.

Summary Report on Tacit Knowledge Research

A recent ARI report (Technical Report 1093) is the final product of a six-year effort, led by our research unit at Ft. Leavenworth, to define, assess and measure tacit knowledge for leadership among U.S. Army officers. Tacit knowledge is defined as knowledge grounded in experience, intimately related to action, and not well supported by formal training and doctrine. Tacit knowledge for leadership was researched at three different levels of command and developed into assessment inventories for each level. The assessment inventories have been construct validated and proven to predict certain leadership effectiveness ratings at each level and to do so better than measures of verbal reasoning ability, tacit knowledge for business managers, or experience. The report describes the constructs of "practical intelligence" and "tacit knowledge", other research related to them, the general methods used in assessing tacit knowledge, and the development of the Tacit Knowledge for Military Leaders inventories. There is also a chapter on the practical implications for leadership development and training. The report is authored by Robert J. Sternberg and colleagues at Yale University, and others at West Point, IBM, ARI, Cornell, and Florida State. An expanded version of this report is a commercially available book entitled Practical Intelligence in Everyday Life by the same authors.

For additional information or to receive a copy of a report, contact Dr. David Witter, ARI-

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